

Chapter 7

Water Supply

The quantity, quality, and availability of water resources are vital to natural processes and human activities. Wise and prudent planning combined with management of surface and groundwater resources is fundamental to providing a substantial economic base for the residents of the CABY region. This chapter presents a broad water supply and demand forecast for the CABY region. Understanding the magnitude of future water demands, potential changes to existing water demands, and constraints to reservoir storage capacities allows managers to make recommendations that will meet and manage water demands into the future.¹ How growth is accommodated and land use planning decisions are made by cities and counties have important implications for future water use.



7.1 Water Supply Overview

The CABY region encompasses the headwaters and transport reaches of four major Sierra rivers. The water purveyors of the region exercise many senior Area-of-Origin water rights to meet the needs of local citizens. Water from the region also contributes substantial supply to the rest of California and the Delta: approximately five million acre-feet per year, which represents about 30 percent of the Sacramento River's total supply. Although the region has abundant surface water supplies, some of it is unavailable locally because of prior water rights appropriations for downstream or out-of-basin users.

Water supplies within the CABY region are predominantly local in origin and thus the region is dependent on local precipitation patterns. Essentially all local precipitation falls between October and May and must be stored either geographically (e.g., meadow storage), geologically (groundwater aquifers), by infrastructure, or as snowpack to provide water supply to the region and the rest of the state during summer and fall. The bedrock of the upland CABY area does not provide reliable aquifers, and importation of water from elsewhere in the state is impeded by elevation (though water is moved between adjacent watersheds in the region). Thus, the CABY region relies in large part on rain and snowmelt stored in reservoirs and redistributed in time and location to provide reliable public water supply through the dry months. Precipitation amounts can also vary widely from year to year. Storage is necessary to provide reliable supply through dry years to sustain beneficial uses of the water supply. CABY is committed to engaging in ongoing conversation about this complex issue.

¹ CDM 2004

Surface Waters

Supply sources in the region for municipal and domestic use and irrigation generally come from surface waters in the form of watershed runoff, carryover storage in surface reservoirs, and recycled water (treating wastewater to meet standards for irrigation and/or agricultural use). Melting snow from the Sierra Nevada provides a direct water supply source that historically has lasted through June or July, though this pattern is already shifting toward a February through April period with a changing climate.² After snowmelt, supplies are provided from surface and groundwater storage throughout the CABY region.

Table 7-1, below, provides a summary of normal year, single dry year, and multiple dry year (third year) water supplies available to the water agencies from the listed river systems for consumptive and/or irrigation use by right or contract.

Water supply availability shown in Table 7-1 is based on the historical hydrologic record and could be affected over time due to a reduction in snowpack and as a shifted hydrology evolves in the Sierra Nevada. The table presents data to 2030 planning as presented in the corresponding Urban Water Management Plans. Water supply availability in some cases includes new supplies currently being pursued by the agency, as is the case for El Dorado Irrigation District. A comparison of normal-year supply to multiple dry year supply illustrates the region's vulnerability to extended drought and climate change. Lack of groundwater for dry-year supplementation is the primary reason for these large fluctuations in water supply reliability. In the northern parts of the CABY region (the Yuba, Bear, and North and Middle Forks American River), impacts to water supply are projected to be less significant in terms of meeting projected local demand than they are in the southern portion of the region. As described in Chapter 10, the Urban Water Management Plans for Nevada Irrigation District, Placer County Water Agency, Georgetown Divide Public Utility District, and El Dorado Irrigation District are revised every 10 years based on updated State and federal policies.

² NID 2005

Table 7-1 Normal and Multiple-Dry-Year Water Supplies by Agency							
Water Agency	2015 Supply (AF)	2015 Multiple Dry Year Supply (AF)	2020 Supply (AF)	2020 Multiple Dry Year Supply (AF)	2030 Supply (AF)	2030 Multiple Dry Year Supply (AF)	Supply Source
El Dorado Irrigation District	79,046	64,949	110,568	69,949	122,420	69,949	SF American, NF Cosumnes, Folsom Reservoir, Echo Lake in the Tahoe Basin
Georgetown Divide Public Utility District	12,200	11,060	12,200	11,060	12,200	11,060	MF American (Rubicon)
Nevada Irrigation District	410,828	333,944	410,828	333,944	410,828	333,944	Yuba, Bear
Placer County Water Agency	251,549**	251,549*	289,124* *	289,124*	291,494**	291,494*	Yuba, Bear, MF American

Source: Urban Water Management Plans

*Number reflects compiled totals from Tables 8-7, 8-8, and 8-9 in the PCWA Urban Management Plan

**Number reflects compiled totals from Tables 8-1, 8-2 and 8-3 in the PCWA Urban Management Plan

Table 7-2 lists the primary reservoirs and corresponding operators that supply the surface water needs both within the region and for export from the region. In addition to the major reservoirs and lakes listed below, several small water agencies in the CABY region have water rights and own and operate small-scale conveyance and storage facilities.

Table 7-2
Major Reservoirs and Lakes in the CABY Region

Reservoir/Lake	Stream/River Outflow	Capacity (AF)	Operator
Bowman Lake	Canyon Creek (Yuba)	68,510	NID
Camp Far West	Bear	104,000	DWR
Caples Lake	Silver Fork of the American	22,340	EID
Collins Lake	Dry Creek	1,600	Browns Valley Irrigation District
Combie Lake	Bear	5,560	NID
Englebright	Yuba	70,000	U.S. Army Corps of Engineers
Faucherie Lake	Canyon Creek (Yuba)	3,980	NID
Fordyce Lake	Fordyce Creek (Yuba)	49,900	PG&E
French Lake	Canyon Creek (Yuba)	13,940	NID
Folsom	American	975,000	U.S. Bureau of Reclamation
French Meadows	MF American	136,400	PCWA
Hell Hole	Rubicon	207,600	PCWA
Ice House	SF Silver Creek (SF American River)	45,960	SMUD
Jackson Lake	Jackson Creek (Yuba)	1,330	NID
Jackson Meadows	MF Yuba	69,210	NID
Jenkinson Lake	Camp Creek	41,000	EID
Lake Aloha	SF American	5,004	EID
Lake Valley Reservoir	North Fork of the North Fork American	8,000	PG&E
Loon Lake	Rubicon (MF American)	76,500	SMUD
New Bullards Bar	Canyon Creek (Yuba)	966,103	Yuba County Water Agency
Rollins	Bear	66,000	NID
Sawmill Lake	Silver Fork of the American	3,030	NID
Scotts Flat	Dry Creek	48,550	NID
Silver Lake	Bear	8,640	EID
Slab Creek	Yuba	16,600	SMUD
Spaulding	Canyon Creek (Yuba)	75,000	PG & E
Stumpy Meadows	American	20,000	GDPUD
Union Valley	MF American	277,300	SMUD

Source: Reservoir information obtained from DWR, Division of Flood Management website: <http://cdec.water.ca.gov/misc/resinfo.html>) and from agency sources

Recycled Water

The use of recycled water, which involves tertiary treatment of municipal wastewater to meet Title 22 standards, is becoming an increasingly important water supply in the CABY region. Though recycled water is currently used in the region, the increased demand for water is fueling efforts to expand its use. Leading the recycled water use campaign is EID, which has produced recycled water for over 35 years. Today, EID delivers tertiary-treated recycled water for landscape irrigation to more than 3,600 homes,

200 commercial sites, and a golf course in the El Dorado Hills area, totaling approximately eight percent of its overall deliveries.³ The use of recycled water is impeded in much of the CABY region by high topographic relief and low population densities, which makes centralized wastewater collection, treatment, and redistribution systems uneconomical. In the future, however, the expanded use of recycled water, where practical, will be a resource to help meet the region's growing water demand.

Return Flows

Return flows are also an important water-supply component in the CABY region and differ from water recycling in that return flows are not treated or used for primary demands such as consumptive water rights and in-stream flows. Groundwater, for example, requires a significant supply of water (or recharge) from a variety of sources (e.g., meadows, ponds, irrigation, canals, percolation beds, and wastewater treatment plant discharges). Return flows can recharge groundwater supplies. A specific example of return flows is the mandatory discharge of one million gallons per day at the EID Deer Creek Wastewater Treatment Plant. Because the actual quantity of return flows in the CABY region is not known and difficult to accurately estimate, for the most part, this water is considered incidental or secondary to other primary demands. A better understanding of the relationship between primary water demands and return flows demands is needed in order to effectively manage conservation strategies in the CABY region.

Groundwater

In general, groundwater in this area is an inadequate and unreliable water supply for large-scale use. However, many rural homes, farms, and ranches throughout the CABY region rely on groundwater supplies, with individual wells. The fractured bedrock formations that constitute much of the Sierra Nevada foothills and western slopes of the mountains are poorly suited to contain large quantities of groundwater. Water cannot penetrate the rocks unless there are fractures, as there is no pore space between the grains of the rock. Where rock fractures are present, small amounts of water can be stored and made available to wells that intersect the fractures. While there can be groundwater resources within meadow complexes in the high valleys throughout the region, these sources are limited in scope; overall, groundwater availability is largely restricted to fractured rock areas.

Accordingly, groundwater makes up a small portion of the water supply in the region, constituting only 10 percent of the overall water supply in the Mountain Counties Hydrologic Region.⁴ However, for many individual home, farm, and ranch operations, groundwater may be the only source available to supply their needs due to limitation in water distribution infrastructure. This resource can be unreliable, especially if additional development occurs in a localized area of short supply or during drought periods. In addition, these groundwater supplies are highly variable in terms of water quality (primarily minerals, but also heavy metals). Because of the variability of groundwater supplies, nearly all of the publicly supplied water in the CABY region is provided by surface waters. The only organizations managing the use of groundwater resources are the cities and counties that issue well-drilling permits and mandate water-quality testing for wells that will be on a small public water-supply system, as well as private wells.

³ EID 2012

⁴ DWR 2005

Forest Management to Increase Water Yield

Forest management in the CABY watershed also affects the availability of a reliable water supply. Studies over the past 100 years have found that when the density of forest vegetation is reduced, streamflow runoff (i.e., water yield) of a watershed can be increased (Bosch and Hewlett, 1982). Moore and Wondzell (2005) provide a good discussion of how forest vegetation management affects snowmelt rates, low flows, and peak flows, as well as identifying future research opportunities.

Recently, an additional study is in development by the Sierra Nevada Research Institute at UC Merced, in collaboration with the Center for Information Technology Research in the Interest of Society. This study, “Forests and Water in the Sierra Nevada: Sierra Nevada Watershed Ecosystem Enhancement Project (SWEEP),” proposes testing the hypothesis that forest-management strategies that reduce fire risk and return the historical composition and density of tree species may also result in greater snowpack retention and reduced evapotranspiration, resulting in increased water yield and a shift in timing of runoff to later in the season. The study identifies the American River basin as a viable location for the next phase of these investigations. The project also includes the development of an “Intelligent Water Information System for the American River Basin” that would collect real-time watershed data that could inform more efficient operations of Folsom Reservoir for improved water supply reliability and environmental flows. This study and the initial phase of instrumentation installation have initially been funded by a \$2M National Science Foundation (NSF) Grant. The California Department of Water Resources has approved a small amount of partial funding to expand on the initial work done with NSF grant funding, but due to budget limitations, has not yet been made available. Alternative funding for this work is aggressively being pursued by some CABY water agencies through the Delta Stewardship Council, impending State Water Bond, and the American River Basin IRWMP.

7.1.1 Infrastructure

Some water-supply infrastructure in the region was originally developed to support mining operations, agriculture, and to provide hydropower and later modified to provide public water supplies for domestic, municipal, industrial, and agricultural use especially dry months. Other infrastructure was developed specifically to provide water supply, with other ancillary benefits such as hydropower and recreation.

The CABY area includes the water infrastructure of several irrigation districts, municipal water agencies, county water agencies, and utility companies. These entities’ facilities include an array of canals, flumes, tunnels, ditches, pipelines, penstocks, dams, and powerhouses. The infrastructure provides multiple benefits to the region’s residents, the greater Sacramento area, and to a lesser extent statewide, including treated water, regulated flow for hydropower production, recreational opportunities, environmental benefits and streamflow releases, opportunities for out-of-district sales, aesthetic resources, and agricultural irrigation. The raw-water infrastructure incorporates over 790 miles of canal, 147 dams, 36 powerhouses, and 19 tunnels. The larger dams are operated by water agencies, irrigation districts, public utility districts, the Bureau of Reclamation, the Army Corps of Engineers, Sacramento Municipal Utility District (SMUD), or PG&E. Many small dams and/or diversions in the watersheds are owned and operated by smaller entities or private individuals. Overall, the four major rivers of the CABY region contain a significant amount of water-related infrastructure as described below.

The infrastructure in the CABY region is aging and, in many cases, dates back to Gold Rush era construction and uses. In addition, limitations on reservoir dredging due to mercury contamination from the Gold-rush era impacts traditional methods used to maintain reservoir capacities. Additional

investment in these resources, both from within and outside the region commensurate with benefits received, is essential to continue reliable and cost-effective water supply and wastewater management throughout the region.

Cosumnes River Watershed

While undammed on its mainstem, the Cosumnes River is managed with numerous diversions, altering its natural flow regime. The largest diversion is in the Pollock Pines community and includes Sly Park Dams and Jenkinson Lake.⁵ There are few water storage reservoirs on the Cosumnes River and stream flows are influenced by several small water diversions.

American River Watershed

The American River and its tributaries are managed for water supply, flood control, hydropower generation, recreation, and environmental benefits. The Middle Fork American River Project (FERC No. 2079), owned and operated by Placer County Water Agency (PCWA), is a major supplier of water and hydropower in the region. The project consists of two main reservoirs (Hell Hole and French Meadows); seven dams (Duncan Creek Diversion, French Meadows Dam, Hell Hole Dam, South Fork Long Canyon Diversion, North Fork Long Canyon Diversion, Interbay Dam, and Ralston Afterbay Dam); and five hydropower plants (French Meadows, Hell Hole, Middle Fork, Ralston, and Oxbow powerhouses).⁶

The Upper American River Hydroelectric Project (UARP, FERC No. 2101), owned and operated by the Sacramento Municipal Utility District, is a major supplier of hydropower to Sacramento County and provides storage for a significant amount of the City of Sacramento's water supply. The UARP diverts and regulates water in portions of the Rubicon River, Silver Creek, and South Fork American River watersheds. The project consists of three main reservoirs (Ice house, Loon and Union Valley), eleven reservoirs (Rubicon, Buck Island, Loon Lake, Gerle Creek, Robs Peak, Union Valley, Ice house, Junction, Camino, Brush Creek, Slab Creek) and eight powerhouses (Loon Lake, Robs Peak, Jones Fork, Union Valley, Jay Bird, Camino, Slab Creek, and Whiterock) and generates enough electricity to meet about 20 percent of the SMUD customer demand in Sacramento County. Total gross storage of the project is 400,000 acre-feet and total installed hydro generation capacity is 688 MW. Currently all of the water supply and hydropower benefits from the project are exported out of the CABY region to Sacramento County.

On the South Fork of the American River, PG&E owns and operates the Chili Bar Reservoir and powerhouse downstream of the UARP, while EID owns and operates the El Dorado Hydroelectric Project (FERC #184) which includes four storage reservoirs (Lake Aloha, Echo Lake, Silver Lake, and Caples Lake), 22 miles of canal, and the El Dorado Powerhouse. On the lower American River, the Bureau of Reclamation operates the Folsom Powerhouse, part of the Central Valley Project (CVP).

Bear River Watershed

The Bear River watershed is extensively managed for water conveyance. Both NID and PG&E utilize the Bear River watershed to convey water supplies to residents, farms, and ranches of Nevada and Placer Counties, as well as to generate hydropower for the California electric grid. Water is imported from the Yuba and American Rivers into this watershed. An estimated 200,000 acre-feet of water is imported

⁵ EID 2012

⁶ Placer County 2006

annually from the South Yuba River, from Spaulding Lake through the Drum Canal system, and from the North Fork of the North Fork American River through the Lake Valley Canal. Water in the upper Bear watershed is directed into Rollins Reservoir. PG&E's Bear River Canal (below Rollins Reservoir) and the NID's Combie Phase I Canal (below Combie Reservoir), serve as important conveyance systems. Flows in the watershed are managed primarily by the NID, and PG&E.⁷ Dams on the Bear River include Rollins Dam and Camp Far West Dam.

Yuba River Watershed

The resources of the Yuba River are managed for multiple beneficial uses, including water supply, hydropower generation, recreation, flood control, and environmental benefits. Entities with management responsibilities include: NID, South Feather Water and Power Authority, PG&E, Yuba County Water Agency (YCWA) and small and individual water rights holders. Water is transported through a system of tunnels and canals to the Feather, Bear, and American Rivers. The New Bullards Bar Dam, which forms New Bullards Bar Reservoir, is located on the North Fork Yuba River and is operated by the YCWA, whose service area is located outside of the CABY region. The Middle Yuba River development includes: Jackson Meadows Dam operated by NID, which stores water that is later transferred to the South Yuba via the Milton-Bowman Conduit and Bowman-Spaulding Canal. Also on the Middle Yuba River is the Our House Dam located southwest of Camptonville. This dam diverts Middle Yuba River water through a tunnel into Oregon Creek, and then further diverts water into the Lohman Ridge Tunnel and sends it the New Bullards Bar area where it is used to generate hydropower in the Yuba River Development Project (FERC No. 2246). Spaulding Dam on the South Yuba River diverts 66 percent of flow from the South Yuba, and Spaulding Lake is the major reservoir for the Drum Spaulding Project (FERC No. 2310) owned and operated by PG&E. The Englebright dam, located on the Yuba River, generates hydropower and provides recreation opportunities.

Downstream

The rivers and streams in the CABY region provide water for the CALFED Bay-Delta system, the State Water Project (SWP), and the CVP. This water-supply infrastructure depends on a complex system of dams, reservoirs, power plants, pumping plants, and canals to deliver water to users, provide electricity, and for flood control protection. The CALFED Bay-Delta Authority was created in 1995 to address environmental and water management problems associated with the Bay-Delta system, an intricate web of waterways at the junction of the San Francisco Bay and the Sacramento and San Joaquin River Delta. Water flowing out of the CABY region drains to the Sacramento and San Joaquin Rivers and is used in the CALFED Bay-Delta system. The SWP is a water and hydropower development and conveyance system operated by DWR that supplies water to 23 million Californians and 755,000 acres of farmland.⁸ There are no SWP-operated dams or reservoirs in the CABY region, although water originating in the region is part of the SWP water supply. Reservoirs in the CABY region not only help prevent flooding in the Central Valley and reduce pressure on the downstream levee system in the valley, they provide regulated water supply for later downstream municipal and industrial and irrigation use outside the CABY region.

⁷ Eberhart 2006

The CVP, operated by the Bureau of Reclamation, extends 500 miles southward from the Cascade Mountains and stretches 100 miles from the foothills of the Sierra to the coastal mountain ranges. The CVP includes a network of dams, reservoirs, canals, power plants, and pumping plants. The primary function of the CVP is flood control, although uses also include water storage for irrigation and domestic use and hydropower generation. The Folsom Unit is a CVP unit that is partially in the CABY planning area (the North Fork and South Fork arms of Folsom Reservoir extend into the CABY region). The Sly Park Unit (formerly a part of the CVP, but now an EID operation) is located in the Cosumnes watershed and includes Sly Park Dam and Jenkinson Lake on Sly Park Creek and Camp Creek Diversion Dam on Camp Creek.⁹ The Folsom Unit is located on the lower American River, near the western boundary of the CABY region. The primary feature of the Folsom Unit is Folsom Dam, which is a key facility for flood control, water supply for irrigation and domestic use, and hydropower generation in the region and the Central Valley.

7.1.2 Interbasin Water Development

One of the features of the CABY region's water development strategy has been to move water from one river basin to another to best serve the public interest. Such water development has been encouraged by California law since the 1850s and is an integral part of meeting the needs of the CABY region and providing water for all beneficial uses. These interbasin water projects are, in some cases, subject to the continuing jurisdiction of the State Water Resources Control Board because the rights involved are post-1914 appropriative rights. Many (if not most) of these projects seek to capture flows during the winter season and use them to meet demand from municipal/industrial users, agricultural users, and the environment for water during the summer. Indeed, even though the primary purpose of most of these projects is to meet consumptive demands for water, without such interbasin projects, many of the rivers in the CABY region would be much less hospitable to fish during the summer months and would provide many fewer opportunities for water-contact recreation.

Six areas within the CABY region involve major interbasin water development: North Yuba to the South Fork Feather (via the Slate Creek Tunnel); Middle Yuba to South Yuba to Bear River; South Yuba to American North Fork of North Fork American to Bear River; Upper Truckee to South Fork American (via the Echo Conduit); and South Fork American to Jenkinson Lake (North Fork Cosumnes watershed).

The movement of water from the North Yuba River to the South Feather River is based on an agreement between the YCWA and the South Feather Water and Power Agency. Water is transported from the North Yuba watershed to the South Fork Feather watershed for use in hydropower generation. Water from Slate Creek, a tributary to the North Yuba, is intercepted by the Slate Creek Diversion Dam, and conveyed via a 2.5-mile tunnel to Sly Creek Reservoir, a tributary to the South Fork Feather River. From 2000 to 2005, an average of 78,000 acre-feet per year of water was transferred.¹⁰

The movement of water from the Middle Yuba River to the South Yuba River to the Bear River occurs under FERC #2266 for NID's Yuba Bear Hydroelectric Project. NID is the licensee, owner and operator, and NID and PG&E coordinate operations in the project. Under the license, approximately 30,000 acre-feet per year of Middle Yuba water is conveyed via the Milton-Bowman Conduit and Bowman-Spaulding Canal to the South Yuba watershed. From Spaulding Lake in the South Yuba watershed, a portion of the

¹⁰ USGS 2006a

original Middle Yuba water flows into the Drum Canal and eventually the Bear River, and another portion flows into the South Yuba Canal and eventually to Deer Creek (a tributary to the South Yuba). This conveyance of water provides irrigation and domestic water to NID's customers in addition to the hydropower generated.¹¹

The movement of water from the South Yuba and North Fork of the North Fork of American River to the Bear River occurs under FERC #2310, PG&E's Drum Spaulding Project. PG&E and the NID also have separate hydropower generating plants and developed water supply and power purchase agreements within this system.¹² Under this system, North Fork of the North Fork American water is conveyed via the Lake Valley Canal to the Drum Canal, which deposits a portion of its flow into the Bear River. Gage readings (from USGS Gage 114126190) on Lake Valley Canal indicate that an average of 12,650 acre-feet per year was conveyed from the North Fork American River watershed to the Bear River watershed from 1990 to 1998.¹³

The conveyance of water from Echo Lakes to the South Fork American River is managed by EID. Water is conveyed from the Upper Truckee River watershed at Echo Lakes to the South Fork American River watershed and is counted as part of EID's overall water supply. Up to 1,900 acre-feet of water per year can be conveyed via the Echo Conduit.¹⁴ The water is used for hydropower generation, instream flows for environmental purposes, and raw water deliveries. The amount of water conveyed in any given year is dependent upon water demand and the water year type (i.e., dry, normal, wet). EID, also on occasion, moves South Fork American River water through the Hazel Creek Tunnel to Jenkinson Lake, via the El Dorado Canal, to optimize South Fork water supplies.

7.1.3 Administration and Management

Urban water supply in the CABY region is administered and managed primarily by five local public agencies for the benefit of local citizens, complying with pertinent federal and State laws and guidelines. These entities are EID, NID, PCWA, Georgetown Divide Public Utilities District (GDPUD), and El Dorado County Water Agency (EDCWA). Other smaller public agencies and private water companies in the region procure, treat, and distribute water at various levels, generally within geographically limited areas.

EID is a water utility serving a population of over 100,000 residents in El Dorado County. EID was formally organized in 1925 under California's Irrigation District Law (Water Code §§ 20500 et seq.). EID provides drinking water for homes, schools, agriculture, and businesses and supplies recycled water to irrigate yards and public landscapes. EID's facilities and delivery infrastructure for drinking water include 1,295 miles of water pipeline, 27 miles of ditches, 5 treatment plants, 34 storage reservoirs and 38 pumping stations.¹⁵ Additionally, EID owns and operates the El Dorado Hydroelectric FERC Project #184 (described above).

NID was formed to provide a reliable year-round water supply to its local constituents. The District's watershed encompasses 287,000 acres and supplies domestic and municipal water to a population of

¹¹ NID 2005

¹² Foothills Water Network 2006

¹³ USGS 2006b

¹⁴ DWR 2005

¹⁵ EID 2012 Comprehensive Annual Financial Report

over 80,000 individuals and agricultural water to over 5,000 agricultural customers. NID produces over 354 GWh of electricity annually and provides for public recreation and environmental flows in many streams. A significant component of NID's operations is the Yuba-Bear Hydroelectric Project, FERC #2266.

PCWA was created under State legislation entitled the "Placer County Water Agency Act," adopted in 1957. PCWA carries out a broad range of responsibilities including water resource planning and management, retail and wholesale supply of irrigation and drinking water, and production of hydropower energy. PCWA provides water to a majority of Placer County residents.¹⁶ PCWA owns and operates the Middle Fork American River Hydroelectric Project, FERC # 2079, as well as several smaller water rights and a large water purchase contract with PG&E for a substantial quantity of water from the Drum -Spaulding Project (described above).

GDPUD was created in 1946 to provide irrigation and domestic water supply to its constituents. The service area is 112 square miles on the ridge separating the Middle Fork American and Rubicon River on the north and the South Fork American on the south. GDPUD provides domestic and irrigation water service to the communities of Georgetown, Buckeye, Garden Valley, Kelsey, Spanish Dry Diggins, Greenwood, Cool, and Pilot Hill. GDPUD owns and operates Stumpy Meadows Reservoir, a 20,000 acre-foot reservoir on Pilot Creek in the Middle Fork American River watershed.

EDCWA was formed by special act of the California State legislature in 1959. Its boundaries are coterminous with those of El Dorado County. Among EDCWA's authorities are the power to contract for water and to finance and construct, operate, and maintain works for the storage and transmission of water. EDCWA may contract for the sale of water to water purveyors, but is not permitted to retail water directly to customers. The Agency has undertaken the role of overall county water planning, and securing new water supply for the county.¹⁷ The majority of residents of El Dorado County purchase their water from one of five water purveyors: EID, Georgetown Divide Public Utility District, Grizzly Flats Community Services District, South Tahoe Public Utility District, and Tahoe City Public Utility District. The latter two agencies serve customers outside the CABY Region.

In the southern portion of the CABY region, EDCWA coordinates water resource planning efforts within El Dorado County and in 2007 updated its Water Resources Development and Management Plan (WRDMP) in an effort to incorporate new land use and associated water need projections of the 2004 General Plan. The WRDMP water demand projections call for upwards of 100,000 acre-feet (based on a critically dry year) at build-out for the western slope of El Dorado County. The planning area includes the El Dorado Irrigation District, Georgetown Divide Public Utilities District, Grizzly Flats Community Services District, South Tahoe Public Utility District, Tahoe City Public utility District, and other areas in El Dorado County that are not within a water agency's current service boundary.

Several Mountain Counties Water Resources Association member agencies are participating in Reclamation's ongoing Sacramento and San Joaquin River Basin Studies to identify imbalances in supply and demand in the watersheds and identify adaptation strategies to address climate change impacts.

¹⁶ PCWA 2006

¹⁷ EDCWA 2003

7.2 Water Demand

Water demand forecasts take into account many factors to make projections of future water use by a given population. For the CABY region, the water demand forecast is calculated using county estimates of population, land use designations, and agricultural data and multiplied using California Hydrologic Region (Sacramento River and Mountain Counties) parameters. For the Sacramento River Hydrologic Region, this includes irrigated acreage and applied water use; for the Mountain Counties Hydrologic Region, this includes population parameters.

The nine counties that comprise the CABY region are located within the Mountain Counties Area as defined by the California Water Plan Update.¹⁸ El Dorado County comprises the largest area in the CABY region, covering roughly 995,000 acres. Placer and Nevada Counties make up the next largest area, covering approximately 629,000 acres and 511,000 acres, respectively. The remaining counties (Alpine, Amador, Butte, Plumas, Sacramento, Sierra, and Yuba) comprise small portions of the region. See Table 7-3, below, depicting these areas.

County	Total County Size (Acres)*	Acres of County in CABY Region**	% of County in CABY Region	County as % of CABY Region
Alpine	468,849	10,664	2	<1
Amador	381,300	61,273	16	2
Butte	1,072,793	1,150	<1	<1
El Dorado	1,145,027	994,962	87	36
Nevada	625,013	510,513	82	18
Placer	958,339	629,029	66	23
Plumas	1,672,731	17,685	1	<1
Sierra	617,470	306,130	50	11
Yuba	411,699	173,224	42	6
Total:		2,786,285		100

*Acreages derived from CASIL's county shapefile and CABY Region Boundary provided by CABY participants

**Acres of county in CABY derived by clipping counties with CABY Region Boundary shapefile

Table 7-4, lists the water demands for multiple dry-year scenarios as presented in the Urban Water Management Plans for the four primary water purveyors in the CABY region.

¹⁸ DWR 2005

Table 7-4 Projected Water Demands				
Water Purveyor	Projected Water Demands for Multiple Dry-Year Scenario (acre-feet per Year)			
	2015	2020	2025	2030
El Dorado Irrigation District	48,921	52,267	60,028	69,620
Georgetown Divide Public Utilities District	7,615	8,844	10,233	11,637
Placer County Water Agency	181,762*	197,121*	213,048*	218,287*
Nevada Irrigation District	180,046	187,360	195,729	200,646

*Number reflects compiled totals from Tables 8-7, 8-8, and 8-9 in the PCWA Urban Water Management Plan

Forecasting water supplies is challenging due to the influence of many variables, uncertainties, and poorly understood factors, such as the effects of climate change upon surface water supplies and water re-use. Other uncertainties include changes in population and economic growth; changes in water use by households, businesses, and public facilities; agricultural land use and production; the needs for irrigation; and future requirements and public desire for increased environmental benefit and/or economic growth.¹⁹ The water forecast for the CABY region should therefore be viewed as a broad forecast used to determine adequate management practices, and not viewed as an exact future water demand calculation.

7.2.1 Land Use

Although the topic of land use is covered more extensively in Chapters 5 and 8, a quick synopsis of predominant land uses and trends is provided here for context in understanding water supply and demand.

Historically, the economies of the mountain and foothill communities of the Sierra Nevada have been tied to the land. Over the last few decades, the CABY region has experienced a shift in land use away from traditional rural land uses such as timber harvesting, livestock grazing, and irrigated agriculture, and toward rural residential developments. This trend has largely been driven by an influx of new residents since the early 1970s.²⁰ CABY's population is expected to increase by 373,732 between 2000 and 2050.²¹ The federal government is the dominant landowner in the CABY region, with most of the higher elevation lands being under the management of the Forest Service and other federal agencies.

A variety of land uses occur in the CABY region. Most are associated with natural resource uses, as the majority of land cover is coniferous forest managed mainly by the Forest Service. Agricultural land use is generally confined to the lower elevations.

¹⁹ Groves et al. 2005

²⁰ Wacker et al. 2002

²¹ DWR 2009

The amount of land devoted to agriculture (including grazing land) and forestry has decreased from 33 percent to 10 percent in Nevada County alone from 1957 to 2001, giving way to residential land uses. Mining and other commercial uses dropped to 2 percent and timber land uses decreased from 31 percent to 18 percent between 1957 and 2001.²² Agricultural land is used primarily for vineyards, Christmas trees, citrus trees, berries, deciduous orchards, and pasture in El Dorado County; and rice, walnuts, cattle and calves, nursery, and pasture and range in Placer County.²³

Currently, urban areas only constitute 1.4 percent of the land cover in the CABY region, but this is expected to change as the region accommodates a large increase in population per projections from Department of Finance/Department of Water Resources. Growth in the CABY region will affect the extent of open spaces and cause significant impacts on natural resources.²⁴ At the same time, it brings with it a larger tax base to pay for essential community services which are otherwise limited in rural areas. With the elimination of traditional land uses such as timber harvesting, farming, and ranching, local rural economies are more dependent on development- and tourism-related revenues.

7.2.2 Current and Future Urban Water Demand

Current projections forecast the population of California to increase 74 percent from 2009 to 2050, which will substantially increase the statewide urban water uses. The Mountain Counties Hydrologic Region, which includes the CABY planning area, is expected to outpace the state population growth with projected increases of 85 percent between 2000 and 2050.²⁵ Most of the population growth in the CABY region, as discussed in the previous section, will be greatest in the foothill urban centers in the western portion of the planning area (e.g., El Dorado Hills, Cameron Park, Auburn, Nevada City, and Grass Valley). (See Table 7-5.) Water agencies in the CABY region are actively securing existing supplies, pursuing supply augmentation, and implementing efficiencies in water use and water delivery systems, to meet future water needs.

Demand Projections

Urban water demand for the CABY region is forecasted using two variables: population and per capita water use (gallons per capita per day or gpcd). Population is the primary variable used to calculate future urban water demand – housing growth, employment growth, and public sector water use are all correlated with population growth.²⁶ Placer County, El Dorado County, and Nevada County contain the majority of the CABY region's population, accounting for 88 percent of the 2001 population.²⁷ Under current population growth projections, these three counties alone will be home to 725,141 people by 2050 (Table 7.5).

²² Walker et al. 2003

²³ Placer County RCD

²⁴ Sierra Nevada Ecosystem Project 1996

²⁵ DWR 2009

²⁶ Groves et al. 2005

²⁷ DWR 2005

Table 7-5 Current Population and Future Estimates per County within the CABY Region						
County	County Area (sq. mi.)	Persons Per Square Mile	Sq. Miles of County in CABY Region	2000 County Pop. in CABY	2013 County Pop. in CABY	2050 Pop. Projected (+85%)****
Alpine	738	2	17	28	34	51
Amador	595	64	96	5,663	6,144	10,477
Butte	1,636	134	82	10,183	10,988	18,839
El Dorado	1,708	106	1,555	142,298	164,830	263,251
Nevada	958	103	798	76,662	82,194	141,825
Placer	1,407	248	983	173,008	243,784	320,065
Plumas	2,553	8	28	228	224	423
Sierra	953	3	478	1,783	1,434	3299
Yuba	632	114	314	29,830	35,796	55,186
Total	11,180		4,351	439,684	545,428	813,416

Sources:

2000 Census information
 Department of Finance 2013
 2010 Census information
 ****DWR 2009

7.2.3 Conservation

The CABY region has long had a culture of water conservation because it is solely dependent on mountain headwaters with limited options to enhance water supplies. Topography and geography limit the potential to import surface water, and bedrock geology renders groundwater unreliable for public supplies.

Unlike many purveyors in the Sacramento Region Hydrologic Region, CABY region purveyors have fully metered and billed services, and have long employed best management practices such as: tiered, inclining block rate structures on a volumetric basis, residential water audits, and canal lining/piping projects. Conversion of unmetered connections to metered connections with volumetric pricing is the primary tool in promoting water conservation. In fact, the California Urban Water Conservation Council estimates in its Utility Operations Program, "Metering with Commodity Rates," a 20 percent reduction in demand should result from metering and volumetric pricing. This would imply that metering and volumetric pricing alone could satisfy the 20 percent conservation requirement of SB 7X-7 for agencies that currently have unmetered connections. Or that CABY agencies already metering and employing volumetric pricing, have achieved 20 percent water conservation. Since traditional water conservation practices have already largely been employed by CABY water purveyors, it will be more difficult and costly to achieve an additional 20 percent savings.

In any case, additional conservation efforts are underway by all purveyors, at varying levels, to start (or continue) an Agriculture Irrigation Management Service for growers. For example, EID's IMS program saved over 2,000 acre-feet annually during the first several years of its deployment. In NID's service area, less than 10 percent of annual water deliveries are for potable domestic purposes; therefore, most

of NID's conservation efforts are focused on raw-water delivery systems. PCWA also operates an extensive water efficiency program.

One of the projects included for implementation is the Main Ditch Improvement Project, which includes the piping of three miles of open unlined ditch in EID's service area to save an estimated 1,300 acre-feet of water currently lost to seepage.²⁸ Another program aimed at conserving water and meeting future needs is EID's water recycling program. EID has been using recycled water for over 35 years.²⁹ Such water conservation and efficient use will be a necessary component in meeting future water demand in the CABY region.

Senate Bill X7-7 was enacted in November 2009, requiring all water suppliers (urban and agricultural) to increase water use efficiency. Urban conservation as described in this bill, is measured in gallons per capita per day (gpcd), and must decrease by 20 percent by the year 2020. Urban per capita water use includes residential (including landscape), commercial, industrial, and institutional uses of water. Each urban water supplier (providing more than 3,000 acre-feet annually or serving more than 3,000 connections) must report the gpcd for their service area based on calculation methods outlined in the bill, and these must be included in their five-year updated Urban Water Management Plans (UWMPs). EID, PCWA, NID, and GDPUD all completed and submitted 2010 UWMPs to DWR, and use projections are based on these numbers. The 'base year,' 2015, and 2020 projections are shown below:

Urban Water Supplier	Base Year (2010, GPCD)	2015 goal	2020 goal	Percent decrease in GPCD between base year and 2020
El Dorado Irrigation District	281	273	225	20%
Placer County Water Agency	298	270	241	19%
Nevada Irrigation District	254	229	203	20%
Georgetown Divide Public Utilities District	197	182	167	15%

The 20x2020 Water Conservation Plan (DWR et al. 2010) identifies the statewide and regional baselines for water based on 2005 data. Per capita urban water use for the Sacramento River Hydrologic Region (SRHR) is 253 gpcd. The 2015 target is a 10 percent reduction of this, or 215 gpcd, and the ultimate 2020 target for the SRHR is 176. For the state, if all urban water suppliers comply with the 20x2020 legislation, gpcd is expected to go down to 154 by 2020, saving nearly two million acre-feet based on a population of 37 million.³⁰ Even with decreasing gpcd, overall use may go up with increasing population in the Mountain Counties Region, as discussed above.

With the exception of GDPUD, GPCD-related consumption in the CABY region is above the SRHR baseline and targets. Residents in urban areas with high housing densities typically have no personal landscape

²⁸ EID 2012

²⁹ EID 2012

³⁰ DWR et al, 2010

space. On the other hand, people in less densely populated areas live in single family homes with landscaped front and back yards; and in rural areas, typical of a large part of the CABY region, people are watering livestock and irrigating gardens and small orchards, and thus use more water. This type of water use promotes regional sustainability because it is more efficient to: grow produce locally, irrigate with gravity-fed water systems rather than with exported water that is pumped and re-pumped; and avoid long-distance produce transport back to these local areas. Current State water policy does not recognize or give rural agencies credit for this water-and-energy-conserving difference between urban and rural water use.

Another issue unique to source-area water supply systems not recognized in State policy is the miles of raw water conveyance systems, typically remnants of the gold rush era, that have a great potential for water savings. These systems are characterized by raw-water conveyance: earthen ditches and lined canals that typically experience greater water loss than urban potable water systems where water is pumped directly out of the river or ground and injected into the potable water system. Regarding conservation credit toward 20x2020 compliance, current State policy draws an arbitrary line for measuring water conservation just downstream of a municipal water treatment plant. This policy provides no incentive for improvements in raw water systems where losses are sometimes the greatest, and therefore little advantage in funding for raw-water projects is tied to that policy.

7.2.4 Current and Future Agricultural Water Demand

California's agricultural production includes over 350 commodities. Agriculture consumes a large portion of the water supply in the state, exceeding domestic use. Although agriculture is a major economic land use in California, agricultural land has been gradually decreasing statewide. Reductions in crop acreage are due mainly to urban encroachment. From 1990 to 2000, 500,000 acres of agriculture land were converted to urban or nonagricultural purposes.³¹

In the CABY region, agriculture occurs primarily in the lower elevations of the Sierra foothills. The upper elevations are steep and dominated by forested lands that are not suitable for agriculture. For the purposes of this Plan, timber harvest and production are not considered agriculture. These activities are covered under land use and management. Thus, the amount of agricultural land in the planning area is small relative to other parts of California. The dominant agricultural use is rangeland and irrigated pasture for cattle production. Crops grown in the area include alfalfa and grass hay, grain, olives, wine grapes, apples, berries, and other deciduous fruits.³²

Agricultural water use for the planning area is forecasted using irrigated crop area and applied water use. DWR has information on both variables for all of the CABY counties for 2001.³³

³¹ DWR 2005

³² DWR 2005

³³ DWR 2001

Table 7-7 Agricultural Acreages per County within the CABY Region					
County	Total County Size (Acres)	*Acres of Agriculture per County	Acres of County in CABY Region	*Acres Ag. Land per county in CABY Region*	% of Total County Ag. in CABY Region
Alpine	468,849	5,217	10,664	0	0
Amador	381,300	11,287	61,273	4,193	37
Butte	1,064,302	268,809	52,398	0	0
El Dorado	1,145,027	8,478	994,962	8,478	100
Nevada	625,013	5,160	510,513	5,152	99
Placer	958,339	44,729	629,029	5,854	13
Plumas	1,672,731	60,408	17,685	0	0
Sierra	617,470	33,135	306,130	25	1
Yuba	410,486	98,917	200,719	866	1
Totals:			2,786,284	24,568	

*Agricultural acreages derived from the California Dept. of Forestry and Fire Protection, Fire and Resource Assessment Program. Downloaded 8/15/06 from: <http://frap.cdf.ca.gov/data/frapgisdata/select.asp>. More accurate data may be available from local agricultural commissioners

Note: Because the irrigated area totals for each county do not depict their geographic locations, it is difficult to determine the exact irrigated area of the county that falls within the CABY region. This is problematic as the CABY planning area encompasses large portions of some counties and small portions of others. To calculate the acreage of each county's irrigated crop area that is within the planning area, a Geographic Information Systems (GIS) analysis was performed. The GIS analysis used the California Department of Forestry and Fire Protection's (CDF) Land Cover Mapping and Monitoring Program data (LCMMP) to determine the percent of each county's agricultural land area in the CABY region. This percentage was then multiplied by the DWR's 2001 irrigated crop area per county to determine the possible extent of irrigated agriculture for each county in the planning area. It must be noted that more accurate information is available from county agricultural commissioners and local officials; this method was chosen for plan consistency and ease of comparison.

The LCMMP data (shapefiles) consist of polygons with assigned cover classes (e.g., agriculture, urban, water) that depict land cover for each county. This data was downloaded and imported into GIS (ArcView). It was then merged and clipped using the CABY planning area boundaries, producing a land cover dataset for the entire CABY region. The agricultural acreage of each county within the CABY region was derived from this dataset (Table 7.9). The agricultural acreage was divided by the total agricultural acreage per county to derive the percent of agricultural acres per county within the CABY region: **% of County AG. in CABY** = County Ag. Acres in CABY ÷ County Total Ag. Acres

This percentage (**% of County AG. in CABY**) was then used as a multiplier in which to determine the number of *irrigated* acres per county in the CABY region. The DWR (2001) irrigated acres data for each county was multiplied by the percent of agricultural acres per county within the CABY planning area to determine the acres of irrigated crop area per county in CABY (Table 7-10).

Applied water use, the second variable used to forecast agriculture water demand, is the amount of water needed to grow one acre of a crop. Applied water use, expressed as acre-feet per acre (af/ac), is variable and influenced by soil characteristics, climate, and irrigation management and efficiency. DWR has information on applied water use per crop by county for 2001.

Table 7-8 Total Agricultural Applied Water Use in the CABY Region				
County	Irrigated Acres in County*	Percent of Total County Ag in CABY Region	Irrigation Acres in County in CABY	Applied Water for Irrigated Ag Lands per County (AF/acre)
Alpine	7,130	0	0	4.87
Amador	10,132	37	3,749	2.7
Butte	202,234	0	0	2.77
El Dorado	9,892	100	9,892	2.55
Nevada	7,223	99	7,151	3.4
Placer	30,247	13	3,932	3.61
Plumas	20,229	0	0	1.96
Sierra	6,955	1	70	3.58
Yuba	70,987	1	710	3.44
Total Acres:			25,504	Avg = 3.29

*2007 Census of Agriculture

Total Applied Water use (ac-ft/yr) = (Total irrigated acres) X (Average Applied Water use) 2001

California Dept. of Water Resources (DWR) 2001

Note: Applied water use per county is derived by averaging the applied water use for all crops grown in the county. Use ranged from 1.96 to 4.87 af/ac for the counties in the planning area, with an average of 3.29 af/ac (Table 7.10).³⁴ The CABY region hosts vast differences in soil types and large topographical and cultural practices differences. While a clearer statement of water need would include an evaluation of the amount of water applied versus evapotranspiration rates from all different crops at a variety of elevations in the region, this calculation isn't completed at this time by any entities doing work in the region. Applied water can include water from public sources as well as that from water wells and extracted by riparian right from local streams.

Applied water use in the Sacramento River Hydrologic Region is expected to decrease by 2030 for two of the three scenarios. A decrease of two percent and four percent is projected under the Current Trends and Less Resource Intensive scenarios, respectively. Under the More Resource Intensive scenario applied water use is projected to increase by two percent.

Regardless of the scenario considered, this methodology does not recognize the efforts of at least some CABY counties to protect agricultural land and promote future growth of agriculture as a means to preserve the rural nature of these counties and promote agricultural tourism. For example, the El Dorado County 2004 General Plan promotes a land use pattern that preserves agriculture to ensure its long-term viability by designating agricultural districts, identifying the principal use of these districts as agriculture, and discouraging incompatible uses, such as high-density residential. Limiting parcel size to 20 acres or more, allowing clustering of residential developments on non-choice soils, and imposing minimum setbacks within agricultural districts are all policies identified in the General Plan that will preserve and encourage agricultural growth in El Dorado County.

³⁴ DWR 2001

7.2.5 Current and Future Environmental Water Demand

Environmental water use is defined by the DWR as the amount of water purposefully allowed to flow through natural river channels and wetlands that is not diverted or used for urban or agricultural purposes.³⁵ In other words, environmental waters are waters set aside or managed for environmental purposes that cannot be used for other purposes in the locations where the water has been reserved or otherwise managed.³⁶ The California Water Plan Update Bulletin 160-98 defines environmental water use as the sum of:

1. dedicated flows in State and Federal Wild and Scenic Rivers;
2. in-stream flow requirements established by water right permits, DFG agreements, court actions, or other administrative documents;
3. Bay-Delta outflows required by State Water Resources Control Board (SWRCB); and
4. applied water demands of managed freshwater wildlife areas.

There is a growing interest in the CABY region to conserve or restore the ecological health and functioning of rivers and their associated wetlands and riparian systems for the benefit of people and nature. It is recognized that alteration to a river flow regime may change the river ecosystem. Resource management entities need to be able to define the environmental components of a river's flow regime that will support the desired ecosystem and to quantify the ecological impacts of changes to the flow regime caused by artificial influences, such as water withdrawals, dam operations, and water releases for recreational rafting. No simple figure can be given for the environmental flow requirements of river ecosystems. Rivers are complex biological systems, knowledge is limited, and much depends on policies and other factors that determine the desired character of the river ecosystem that is being managed. The challenge for resource managers and scientists is to support decision makers in defining the flow regime that best meets the objectives set, or makes the trade-off that society finds most acceptable.

Various factors determine the health of a river ecosystem. These include flow variation and quantity, the physical structure of the channel and riparian zone, water quality, channel management and resource use such as dredging and mining, level of utilization (e.g., fishing), and the presence of physical barriers to connectivity (e.g., dams and diversions). Environmental water demand or in-stream flows for rivers, is the determination of the quantity or volume, through time, required to maintain river health in a particular condition. This may be predetermined or agreed upon based on a trade-off with other considerations. Initially, environmental flows or in-stream water demand was focused on the concept of a minimum flow level, which considered all river health issues to be related to low flows; as long as the flow was kept at or above a critical minimum level, the river ecosystem was thought to be maintained. However, it is increasingly recognized that all elements of a flow regime, including floods, medium and low flows are important. Thus, any changes in flow regime will influence the river ecosystem.

To address these challenges, major tributaries of the Yuba, Bear, and American Rivers have undergone FERC relicensing processes during the last decade. More than \$100 million dollars in public funds have been invested in environmental studies and public collaboration to establish river flow regimes seeking to balance the beneficial uses of water resources in the affected reaches. These flow regimes and associated environmental parameters are actively monitored and reported to regulatory agencies such as FERC, CDPH, and the SWRCB in accordance with the FERC licenses. In addition to the FERC process,

³⁵ Groves et al. 2005

³⁶ DWR 1998

non-regulatory efforts are beginning in the CABY region to identify opportunities for voluntary changes in water management that individual water users can implement to benefit local in-stream flow conditions.

Most watershed resources are managed to some extent for social, environmental, and economic needs. The challenge for scientists and managers is to help decision makers predict the consequences of varying degrees of alteration of the flow regime so that the implications to society are understood; in return, the goals for river management must be clarified so that scientists can determine appropriate flow recommendations. Moving toward restoring flow regimes that mimic natural variability is a goal of some stakeholders. A range of methods now exists to achieve environmental water demand and in-stream flow targets: these methods are being applied through FERC relicensing and SWRCB water rights terms and conditions, although acceptable methods can otherwise vary by stream.

Major tributaries in the American, Bear, and Yuba River watersheds have or are undergoing FERC relicensing proceedings which can affect water allocations. These proceedings are supported by extensive environmental analysis and collaborative effort between regulatory agencies, recreation interests, environmental organizations, and utility providers. Further refinements of the understanding between quantities and timing of flows and environmental effects have been an outcome of these collaborative analyses.

Data from the DWR Water Portfolio (2009) for the Mountain Counties Hydrologic Region is used to forecast the CABY region's environmental water demand. Much of the dedicated environmental water use in the Mountain Counties area is subsequently diverted and used by downstream users. In addition, the major foothill reservoirs at the western edge of this area contain water dedicated to Bay-Delta outflows. The CABY region provides water to the applied water demands of managed freshwater wildlife areas in California, and managed wetlands occur in the planning area.

In California, flows in Wild and Scenic Rivers constitute the largest environmental water use.³⁷ The CABY region contains approximately 65.3 miles of Wild and Scenic Rivers and includes 26.3 miles of the North Fork American River from its source to the Iowa Hill Bridge, and 39 miles of the South Yuba from Spaulding Dam to the upper limit of Englebright Reservoir.³⁸ Designated flows from Wild and Scenic Rivers are available for other uses downstream, but not available in the Wild and Scenic designated areas. For 2001, DWR calculated the environmental water demand for the North Fork American and South Yuba Rivers as 229,590 acre-feet and 83,741 acre-feet, respectively.³⁹ Rivers identified as Wild and Scenic candidates can be found in Chapter 5, Region Description.

In-stream flow is the water maintained in a stream or river for beneficial uses such as fisheries, wildlife, aesthetics, and recreation. In-stream flow is a major factor influencing the productivity and diversity of California's rivers and streams⁴⁰ and flow requirements are established by the SWRCB to protect and maintain aquatic ecosystems. It is difficult to forecast future regulatory actions and agreements that could change existing in-stream flow requirements. Thus, for this environmental water demand forecast, only the projected in-stream flow requirements for the American, Bear, and Yuba Rivers that were calculated by DWR are presented (DWR 1998).

³⁷ DWR 1998

³⁸ DWR 2002

³⁹ DWR 2002

⁴⁰ DWR 1998

A complete environmental water demand forecast that analyzes the effect of water rights on water availability and contains a reach-by-reach analysis of in-stream flow requirements is a gap in knowledge in the CABY Region, similar to the rest of the state. DWR estimates for in-stream flow requirements, presented above, are based on only the largest downstream requirements and are not cumulative for rivers with multiple in-stream requirements, of which there are many in the planning area.⁴¹ The most appropriate time to complete an environmental water demand forecast would be after the renewal of all FERC licenses in CABY are complete (licenses throughout the region will be complete before or by the end of 2013). It is expected that changes resulting from the FERC licensing process will have a direct effect on the environmental water demand for the CABY region.⁴²

7.2.6 Water Supply and Climate Change

Climate change will likely alter the timing and amount of water available within the CABY region and water managers will be challenged to adapt to these changes. As discussed in Chapter 11, climate change is expected to intensify seasonal water shortage (due to less snowpack, earlier snowmelt, and precipitation occurring more often as rain than snow). Although geography and high occurrence of microclimates will influence these changes, higher air temperatures are predicted for the warmer seasons, generally resulting in less available water overall (McKenzie 2004; Miller 1999; Taylor 2009).

Water delivery managers and purveyors, and hydroelectric generation managers may face more complex hydrologic management system adjustments when accommodating more frequent intense rainfall events and a reduction in late season snowmelt. Uncertainty puts added pressure on managers who are charged with delivering a resource necessary to meet the demands of growing economies, populations, and releases for the environment and recreational purposes.

About 66 percent of the nation's scarce freshwater resources originate on forested lands. Healthy forests capture and store water, naturally regulate streamflows and water quality, reduce flood and storm damage, control erosion, and replenish groundwater. High-elevation forests in the CABY region protect and enhance water supplies downstream because water supplies are mostly stored as snow cover. It is these critical areas that are particularly vulnerable to climate change and which are projected to decline (due to the increased climate-related phenomena of fire, disease, and insect damage) in the next hundred years. Projected earlier spring runoff and reductions in snowpack, coupled with limited storage and compromised forest water retention, will likely reduce water availability downstream, especially during the summer and fall months. Higher water temperatures, flooding, and droughts are likely to affect water quality and exacerbate water pollution.

Each of the four CABY region water agencies has its own model for operational decision-making and each is prepared to adapt to critical low flow years and multiple low-flow water years. A regional perspective as climate change models and strategies evolve may be beneficial to those charged with managing resources in the diverse setting of geography, elevation, and storm tracks. However, an overarching climate strategy across the region may not be feasible or appropriate; there are too many variables in geography, elevation, storm track, values being managed.

⁴¹ DWR 1998

⁴² Additionally, the Lower Yuba River Accord dictates the in-stream flow regime of the Lower Yuba River. The Yuba River Development Project license expires in 2016 and the new license may result in modifications to the in-stream flows specified in the Accord

7.3 *Future Outlook Considering Water Supplies and Demands*

A comparison of the projected region water demands (Table 7-4) with the projected water supplies (Table 7-1, Normal and Multiple-Dry-Year Water Supplies by Agency) suggests that most parts of the CABY region have sufficient water to meet future needs in both normal and multiple dry water years. Nonetheless, statewide and regional efforts could dramatically impact the water supply reliability in the CABY region. Additionally, GDPUD demand outpaces supply by 2030, and for EID, new supplies are assumed in the 2030 supply number in order to meet demands. It should also be noted that additional water supply need is projected in areas outside of water agency 'Service Areas,' but within their 'Spheres of Influence,' that may be provided by the agencies in the future. In particular, in El Dorado County, the EDCWA 2007 Water Resources Development and Management Plan identifies urban demand of 11,040 AFA and 1,318 AFA that may be provided by EID and GDPUD, respectively. General Plan Amendments can also influence future demands, as is the case in El Dorado County where an additional 13,630 AFA in commercial water supply is expected to be provided by EID and GDPUD. That demand is not currently reflected in the UWMPs because it is projected to occur beyond 2030.

In an effort to meet the projected water demands both inside and outside purveyor service areas, EDCWA continues to pursue a Central Valley Project Water Supply Contract under PL 101-514 (Fazio) and has also been successful in negotiating annual storage and delivery of up to 40,000 acre-feet as part of the FERC re-licensing of SMUD's Upper American River Project. In conjunction with the SMUD agreement, EDCWA, through the El Dorado Water and Power Authority (EDWPA) is pursuing water rights to that water through a petition to the SWRCB for assignment of a State-filed application. EDWPA is currently working with downstream water agencies to develop project elements that would minimize impacts to the lower American River. One of the project elements currently being considered by EDWPA is in-lieu groundwater banking that would provide for EDWPA water to be banked in the Sacramento Groundwater Basin or Sacramento Central Groundwater Basin in wet years for use by Sacramento purveyors in dry years in lieu of surface water from the American River.

The following issues that face the region can potentially impact water demands and water supplies and are under active investigation:

- Climate change and associated hydrologic impacts
- Aging infrastructure
- Improved integration of water infrastructure systems
- Urban conversion of current land uses
- Protection of water rights
- Water quality
- Watershed and ecosystem protection
- Integration with statewide water planning efforts
- State policies and regulations
- Surface and groundwater storage opportunities
- Water use efficiencies
- Inter and intra regional cooperation

Finally, water demand in the CABY region is met not only by ensuring adequate water supply, but by ensuring adequate water supply infrastructure to meet storage, treatment, and distribution needs of water users. EDCWA's WRDMP and EID's Integrated Resources Master Plan (2013) each identify the need for additional surface water storage to meet the long-term water supply needs in dry years in El

Dorado County. The IRWM Plan promotes projects that address specific infrastructure needs as well as overall water reliability for the region. These projects are discussed further in Chapter 12 and they address water conservation, water recycling, and other water enhancement projects.